anticipation

CHRISTIAN SOCIAL THOUGHT IN FUTURE PERSPECTIVE

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These papers are circulated for the information of participants in the ecumenical enquiry on "The Future of Man and Society in a World of Science-Based Technology". Comments are welcome.

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EDITORIAL NOTE

The end of June 1970 saw over 100 people from across the world - scientists, technologists, social activists, planners, theologians - gathered in Geneva for a week, to hammer out issues and priorities for the World Council of Churches' new study project on ethical dilemmas involved in planning for the future use of technology.

Although claiming to be no more than an exploratory conference, the meeting attracted a good deal of attention in many countries. An interpretative report of its deliberations will be available from the W.C.C. Department on Church and Society in November.

Meanwhile, in response to a demand for copies of remarks made at the conference, staff have transcribed and edited some of the key presentations for inclusion in this and the next issues of Anticipation.

Setting the context for the debate were German biologist Dr. Ernst von Weizsäcker (Forschungsstätte der Evangelischen Studiengemeinschaft, Heidelberg) and Japanese political scientist Prof. Kinhide Mushakoji (Professor of International Politics and Director of the Institute of International Relations, Sophia University, Tokyo). The panel dealing with "Ecological Prospects: The Challenge to a Responsible Use of Natural Resources" consisted of Prof. J.N. Black (Professor of Forestry and Natural Resources at the University of Edinburgh), Dr. M. Batisse (General Secretary, UNESCO Intergovernmental Conference of Experts on the Scientific Basis for the Rational Use and Conservation of the Biosphere), Dr. M.T. Zen (Associate Professor in Geophysics/Vulcanology and Chairman of the Geophysical Laboratory, Bandung Institute of Technology), and Prof. F.H. Knelman (Chairman of the Department of Humanities of Science at Montreal's Sir George William University).

"Human Implications of Discoveries in the Biological Sciences" was introduced by Prof. Warwick E. Kerr (Professor of Genetics at the University of Sao Paulo), Prof. L. Charles Birch (Head of the School of Biological Sciences at the University of Sydney), Prof. Angar P. Nygaard (Professor of Biochemistry at the University of Bergen, Norway), and Prof. Nobuaki Sawada (Professor of Biology in the Biological Institute of Japan's Ehime University).

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II(a)

THE HOPES OF A SCIENTIFIC AGE

Dr. Ernst von Weizsäcker (Germany)

The hopes vested in new discoveries in the scientific field are concentrated almost exclusively in the field of biology. People's hopes for a better world are frequently based on technology, or politics, or on new spiritual movements which I like to denote as theology in the widest sense. In these introductory remarks to this Conference on the future of man and society, I should like to justify the unique position of biology with a few examples, then to indicate briefly my hopes and fears concerning the development of technology and politics, and after that to venture as a non-theologian a few ideas on a deeper founded mastering of the situation.

I

Let us have a look at catalogues of recent scientific dissertations. Under physics, we find alternately either very specialised publications in fields where the basic principles are known or very abstract and theoretical ones which perhaps point to a last and basic question put to physics. Dissertations leading to entirely new and significant lines of study are a thing of the past. We find a similar picture in chemistry. Here - and the same is however true for certain fields in physics - there is more emphasis put on application than on fundamental research. Most of the work could just as well have been carried out in industrial laboratories. In biology, however, the picture is quite different. Here almost every dissertation brings to light something qualitatively new and in every case could be made the basis for many years of fruitful further research (I exclude abortive studies, of course, which failed because of human or instrumental inadequacies). Meanwhile the classic fields of biological research are converging. In all fields an understanding in terms of molecular processes is about to be reached. For example, we are beginning to understand the allergic diseases as a result of substantial contributions from biochemistry, physiology, psychology, toxicology, cancer research and indeed from practically all the basic medico-biological disciplines. From this interdisciplinary cooperation an understanding of the molecular processes of allergies emerges.

Let me talk next about two dramatic events of recent years, the implications of which are being discussed even by statesmen and others who are laymen in the scientific field. About three years ago, Professor A. Kornberg succeeded in producing a "test-tube" virus. It is not to belittle his achievement to point out how far this still was from creating life by artificial means. What Kornberg did, to put it in simplified terms, was to take ordinary viruses and to make them produce their negative copy (Nucleotide-sister-chain). He then separated the viruses from the newly-produced molecular chains of the negative copies and made the latter in turn produce positive copies. He again split the double chain and isolated the new positive chains. The latter proved just as virulent as the original viruses. By this two-stage copying process Kornberg produced, therefore, molecular chains of the kind already existing in nature. The difficulties involved in the experiment lay rather in the purification of

enzymes (also derived from nature), than in the preservation or even the making of a new nucleotide-sequence.

Another experiment has achieved fame in recent weeks: Professor H.G. Khora of Madison, Wisconsin, U.S.A., working with a team of Europeans, Asians and one American, has in several steps of synthesis succeeded in producing a genetic molecule (DNA) with a correct sequence, i.e. a sequence such as we find in the natural genetic material. Here it was not a case of a mere copy but of actually achieving a refined synthesis out of fragments, although here again, still on the basis of a natural pattern.

Development continues along these lines. Science is beginning to come to grips with the central molecular mechanisms of our human genes and of the body functions and is able to act upon them: first it copies, then it corrects, and finally it constructs. A whole new field in biology is only just beginning to open up, namely, cerebral-biochemistry. Some general features of the over-all metabolism of the brain are known but a correlation between contents of thought and molecules has not yet been established. We are still a long way from being able to copy nature, nevertheless we are discovering cybernetic structures which are in themselves fascinating even apart from chemistry. It may take decades before these new approaches of psycho-pharmacology and cybernetic brain theory merge in a precise and detailed molecular understanding.

II

The results of all research are ambivalent. Even where unfavourable aspects loom large or appear to do so, as in cerebral biochemistry and molecular-genetic manipulation, further progress and even an accelerated progress is quite inevitable; - this as a result of our science-dependence. I should myself certainly not use the term hubris for biological research itself, but a tragic hubris certainly underlies the optimistic attitude to scientific discoveries which is fathered by an unquestioning belief in progress. The negative aspect of all human action is being repressed in the Freudian sense.

Manipulative molecular technology is still some distance away. Our question is, "What else does technology promise?" We can foresee a great advance in data processing technology (electronics) as well as a democratisation of this technology, i.e. private individuals and broad sections of the community will have access to information and information-processing in data-banks. As a biologist, I should like to refer to another special trend in data processing: the above mentioned techniques of Kornberg and Khorana and many others can to some extent be carried out by machines directed by computer programmes, thus making it possib to carry out certain mechanical biochemical operations in a precisely calculated sequence. This means that perhaps in a few decades it will be possible for highl complex syntheses of living structures to be achieved by extremely simple laborat programming. This implies a dramatic advance in medicine, production, and manipulation, resulting not just from biology alone but from the synthesis of biology and computer technology.

I have already mentioned manipulation by means of biochemistry, although this as yet scarcely affects our decade. Far more serious for the present is manipulation by filtered information, and by government or industrial control of all sectors of human life. Education, we must admit, has also a manipulative character, in either a positive or a negative sense.

Although being loaded with inherent dangers, politics has also had many positive gains to its credit in the past twenty years: internationalisation has made progress. Due to the greater density of communication and transport in every part of the world the real choices available to the individual have greatly increased. He is no longer exposed to chance as once he was, if only his basic needs are met.

III

The balance sheet of political developments seems on the whole unfavourable. I should like to illustrate the need for qualitative change by looking at the problems of education as a bridge to the intellectual mastery of the scientific age. A purely technological view of the world intended to match new ills as they arose with new technologies and believed it possible to conquer war and the evils of civilisation in this way. It is increasingly clear to us that purely technological plans cannot work unless they are sustained by a broad outlook. From a technological point of view, the millions of new schools and colleges must be used to increase the human resources for technological strategies in the struggle to master our world. But the person who has only learned facts and skills at school or - even worse - by television courses is, according to recent psychology, incapable of planning his own life, of increasing his vital contribution and of training his political vigilance. Even as the technocrat's handyman he is really no use. As Paolo Freire intends with his "conscientisacion" programme, even the illiterate needs to be encouraged to participate actively instead of being nothing but a passive recipient of simple or complex technical processes. (At the beginning of our century, the "Meraner Programme" set up by science teachers in German schools had a similar purpose, though with no political intentions. It put wonderful equipment for the demonstration of experiments in physics into the hands of all pupils.)

"Education" has to lead young or adult people from a receptive, passive attitude to an active attitude, and in most cases this means to a revolutionary attitude. Paolo Freire's "conscientisacion" seeks to bring men to a revolutionary frame of mind even before a possible (and hoped for) political revolution takes place. This frame of mind is intended to forestall any inhuman rigidity or Stalinist tendencies in the post-revolutionary period.

As already hinted at by the "Meraner Programme", the kind of education Freire intends is closely related to a successful making and using of science: the person who is simply passive and meditative in view of a rainbow or a croaking frog will never be a physicist or biologist. On the other hand, as we have already pointed out, the daring assurance the good scientist has of mastering

Clearly the supply of energy, food, clothing and information will increase more rapidly than the world population and, technologically speaking, once the technical problem of harvesting the treasures of the oceans is solved and provided we can avoid unfavourable ecological consequences, world prosperity is in sight. Dramatic changes are taking place in the occupations of most people. The prophets of technology add that the standard of education of the world's population will rise steeply as television and other technological media are extended into the developing countries. But here, if not sooner, large size question marks have to be inserted.

But before turning our full attention to these questions we must look first at the explicit political hopes and dangers.

Most serious apprehensions relate to weapon development. It may still have been possible to regard the hydrogen bomb of the fifties and sixties as a stabilising factor in the world, but subsequent developments leading to the guided missiles which can destroy even reinforced enemy missile launching pads have the very opposite effect since, for one thing, the advantage lies with whoever gets his atomic blow in first, for he no longer need fear any equivalent retaliation. The stabilising balance cannot even be restored technologically by anti-ballistic missiles (ABM) and submarines. The war in Indo-China and other bloody conflicts make it clear enough how far we still are from living in peace. In this context the Chemical and Biological Weapons which are available also to small nations appear to be even more dangerous. This is because these weapons allow an insidious escalation from small-scale applications of tear gas to all-out attacks destroying entire continents. The possibility of adapting Khorana's technique to the creation and breeding of new disease agents against which there would be no protection is already being mentioned. Happily an international agreement strengthening the 1925 Geneva B and C Weapon Convention will in all probability come into force in the near future. Third World countrie ill prepared from the point of view of public health, are rightly apprehensive of the special dangers of B and C weapons, which is why most of them are more than ready for the complete renunciation of these weapons, even though they could use the B weapons as a kind of counter-threat against the great powers. Bearing in mind that every year millions of people in the Third World die of hunger and diseases creeping in under the shadow of famine and that the working capacity of the living is severely hampered by hunger and disease, and bearing in mind that the industrial countries are almost exclusively responsible for this situation, we see how close we really are already to the silent violence of the B weapons. The aid we fail to give is in many quarters seen as a war-like offensive against the underdeveloped countries.

Another major anxiety is now beginning to grip the world, the ghoulish vision of a complete pollution of man's environment, including the oceans. Attempts are now being made to redress the balance a little by purification and regeneration but we are very late on the scene and with the increasing world population the methods of purification employed hitherto are quite inadequate.

nature is something quite questionable. How easily men are blinded by success: how lightly they dismiss the dangers! This is true not only when the area mastered is only a very small part of reality, as for example that of science. Every action, however politically sound and well considered it may be, is based on focussing attention on some aspects, dismissing others. This is inevitable, a law of nature. It applies also, of course, to every failure to act. But every dismissal of aspects implies a fresh danger.

So here too, I think that Paolo Freire's programme can get lost in a vast and blind delirium of revolutionary activity, since a pupil who has once been successfully "conscienticised" can no longer be held back even by his teacher: he will define the direction of his efforts to master his environment on the emotional basis of his initial successes, and these can be very misleading. This is not to criticise Freire: far from it. I admire his theory and practice, but I believe that I can detect even in this programme a profound ultimate ambivalence.

We never escape this basic ambivalence. I can say this even on the basis of science, technology and politics. But is it not a basic truth for theologians and indeed for every Christian? Someone who has always believed in shaping the world by technical means but who with every fresh advance in knowledge and technical possibilities is confronted with a new ambivalence, someone, that is to say, who is all of a sudden faced by the negative aspects, by abuses and by unintended guilt, such a person will easily be gripped by despair, a despair leading to inaction and often, therefore, to further guilt (Schuld). Christians, whether theologians or not, who with Christian optimism lightly dismiss this desperate situation or at any rate do not take it seriously enough are not likely to be of much help to scientists and politicians. So we face, the inadequacies of the following attitudes: a frivolous optimistic belief in technological progress, an attitude of political and technological resignation and a naive Christian optimism.

The "hopes of a scientific age" depend, I think, on our recognising the inadequacy of these three attitudes and on our discovering a <u>fourth</u> way, one of cooperation between scientists, politicians and Christians, one which will make it possible for technologists and politicians to exchange their despair for a constructive shaping of the future. It is my hope that this Conference will contribute to that end.

II(b)

TECHNOLOGY AND THE CULTURAL REVOLUTION

Professor Kinhide Mushakoji (Japan)

What do we mean by science-based technology? It is the man-machine-nature-system where the machine is predominant. Science-based technology is giving within the man-machine-nature-complex the possibility for man to control nature and also for man to control man again. So the machine is used both in terms of controlling nature and man. In this way, modern society is using science-based technology as a basic building block of its social structure. Accepting this definition of modern society, what led modern society to take such a shape? Here the sociologists use the term modernisation. Modern society has been created as the development of modernisation. The idea is that the North followed this path and now the South is going to follow the same path. When we talk about modernisation this is the idea. This view developed under the influence of what I shall call 'technological evolutionism'.

Accepting this view, we can say that this technologically based modern society (where machine is mediating between man and nature and man between man), is the consequence of modernisation. Now modernisation in its historical perspective was brought about as a process of westernisation. Modernisation equals westernisation. (This is again a statement which may not be true, but by oversimplifying the facts we may emphasize the fact that modernisation so far is a process of westernisation.) Here comes our Christian concern because westernisation had a Christian tradition and still has; hence westernisation might mean Christianisation. Some Christians thought that this was the meaning of westernisation. For example, in my country some Christians were proud to say that we represented westernisation, that individualism, the western individualism, was the basis of modern society, and that individualism could not be built without the help of Christian faith. Therefore, Christianisation is the basis of westernisation and westernisation is the basis of modernisation. This is a kind of short-circuit logic but in various ways this kind of short-circuit logic exists in various parts of the world and probably some of our missionaries since the time of Matoerichi had this in mind, that westernisation and Christianisation went hand in hand. Is this the way we want or expect things to develop in the future? This is a basic problem to which I would like this Conference to address itself.

According to technological evolutionism, the process of modernisation must lead to a world-wide technological culture. The machine will play a predominant role in human society. We view the process of history, the progress of history, the progress of mankind, the progress of modernisation as a path smoothly leading to a world where technology will prevail and technology will help man to control nature as well as it will help man to control man. Of course, the latter part is hailed by some but is criticized by others. In any case, according to this technological evolutionism, the control of nature by man is considered a good thing. This is where I was very happy to hear Dr. Panikkar mention the problem whether really we wanted to think that we were

controlling nature. Because in the basic evolutionism I find two aspects: (i) total control of the environment and (ii) uniformisation of the world. By total control of the environment, I mean that the ultimate goal of this technological evolution will be the control of the environment, total control of the environment by man through machine, the assumption being that this is going to be 100% possible, although we have a limited knowledge of science and therefore a limited capability in technology. At present, we are unable to control the environment 100%, but suppose we would acquire a higher knowledge about science and a stronger capability in terms of technology so that we would be able to control 100% the environment. This is the fundamental assumption in technological evolutionism.

The second assumption is especially important because it is completely in contrast with what we see in the present world. It is that the world is going to become a uniform world. The idea is that now we have a technologically sophisticated country and we have/technologically retarded country. At the /a end of this historical development, we will have a uniform world where technology will dominate, not only in Northern countries but in the whole world. There is the assumption that we are going toward a uniform world. Now this is in strong contradiction to what we see in the present world where a deep gulf exists between North and South. Hence, I would like to address myself to two problems, and to explain what this means in terms of this man-machine-nature complex.

The basic assumption of total control, in terms of systems theory, is the man-machine-nature-system. Man is supposed to build a model about nature and then use the machine according to this model. Through this model, man acquires the capability to control nature. Here we have to be very cautious. The assumption usually is that machine helps man to control nature. Actually, it is not the machine in itself which helps us, it is the machine as controlled by man and here man controls machine by inventing a model, by using system analysis. This is where the problem arises. By the very nature of models, it is impossible to build a model which includes the totality of nature. All models are by nature limited and selective: they represent just one aspect of the nature which is modelled. Therefore, the assumption that we can totally control the environment using a model which does not include the totality of the nature, is wrong: by definition it is a mistake and probably this mistake is one of the basic problems we have to face. This is one cause - or perhaps I should say the major cause - for the pollution problem we are now facing. I may be wrong and if so the specialists can correct me but let me take an example. When a doctor wants to cure his patient he may use a model according to which if the patient has a stomach disease he will try to use medicines which will heal the disease. This is a limited model because it is a model about the stomach disease. It will not include the brain of the patient, it will not include his feet, it will not include his heart. If you start with such a limited model, you will probably be able to heal his stomach. The medicine you are using to heal his stomach may have other consequences not

taken into account by the model. The stomach may be healed but probably the heart will be injured and so the man may die. This is not the right approach because the model does not take account of otheraspects of the human body. When you have a factory and its activities and analyze them in terms of system analysis, probably the profit maximisation principle will be put in front, so the factory will function to earn as much money as possible. It will not take account of side effects. Side effects, even if they are predicted, will not concern the designer of this system because he will not be interested in th pollution which may come out of the factory. Now it is possible theoretically to think of a more humanitarian planner who will take account of the poor people around the factory who will have to breathe impure air. You may have humanitarian planners also but even there you still have a theoretical problem because the planner by definition uses a model and the model cannot take account of all aspects of the reality. So, necessarily, there are aspects of the reality which are not predictable. They are novelties, they are uncertainties and so when you build a rational model this is not enough because there are irrational factors. There are the factors which are not analyzable through a rational inquiry. They are problems which are unpredictable. System noise and the error of system models.

In systems models, the basic effort is aimed at reducing or minimizing the error. To minimize 'noise' in the system is your goal. You want to make the system as efficient as possible. But since you cannot include all factors in the model, the planners must take account of the reality. When they build a missile or a space ship, they will have to take into account the fact that unexpected things will happen during the flight of this missile, or space ship. They will not be able to compute the noise or the error but will have to add to the space ship various devices which are redundant. One electric circuit would probably be enough to fly or to control the space ship. But they have to be prepared for the eventuality that this electric circuit may be broken. So, they put in another electric circuit. They have to put many safety measures and that is why in technology the problem of redundancy is taken more and more seriously. This is so in technology, but probably not in social technology. In social technology, people are rational. They want to have an efficient system when they build economic models. They want the economic model to be as rational and efficient as possible. There again, perhaps we should try to be more redundant, and, according to evolutionism, we are too rational. We don't remember that our power is limited.

Another aspect of the problem is uniformity of the world. Here I would like to treat two problems: in terms of 1110, I'd like to make the point that the technological gap and obstacles to the communication of technological information are increasing not decreasing. Technology is used not only to control nature but also to control man. Technology is a source of power. In this world, constituted of nation-states, nation-states want to use technology as a power base to control other countries or not to be controlled themselves. Technology or technological information tends to flow everywhere as water flows

everywhere. So, technological information, too, if there were no obstacles to it, would flow around from highly technological societies - yes, technologically developed societies to less developed societies. Then we would gradually have a uniform world.

This is not the situation because of this power dimension. The powerful countries which monopolise certain technologies want to monopolise their technological know-how as long as possible. And this is a problem which is at the base of technological gaps between Northern countries. In my country, there is this strong feeling about a technological gap between the United States and ourselves which the United States is trying to preserve by various means, including the Treaty of Non-Proliferation, Nuclear Non-Proliferation. This is an issue to debate and I am not going to deal with it. I would like to emphasise that the Japanese are sharing technological know-how with the Americans and with European countries. If we are asked by our neighbouring developing countries of Asia whether we really want to share our technological know-how with them, I am not at all sure we will be happy to give our neighbours, our friends, all our technological know-how. We'll want to keep it because the labour will be cheaper in their countries. If they have the same technological know-how as we have, they will be in a better position. A similar problem may exist in the United States and Japan. In a stratified world, this is a problem which must be faced. We give technological aid to our neighbouring countries and the technological aid is given only in terms of the technological know-how we don't need right now. It is only obsolete or obsolescent technological know-how which we want to hand to the developing countries. It is better than not wanting to give any technological aid. In terms of solving this North-South gap, we are not helping very much. Therefore, this assumption of a world uniformisation process is again misleading.

In this power struggle, I come to my next point - the technocratic control in the world is the problem of how weaker countries are going to react to this kind of control. Are they going to try to invent their own nuclear weapons? Are they going to try to invent new technologies? Some are doing so, but there is another strategy which is paying. It is the strategy of cultural revolutions. This is the strategy which refuses the technological culture, saying that technology is bad and which resists it by becoming a significant noise in the system. By facing rationality with irrationality, by opposing the computer planning of the Pentagon by building, by organising guerrillas in the rice fields of Vietnam. Here you have a very efficient way to cope with the technological approach. The technological model becomes weaker and weaker when it becomes more and more sophisticated. The more complicated a system you build, the less resistent it is to the noise and to a small influence which will help to break down the whole system. A symbolic phenomenon happened in New York some years ago when the elctricity was cut. When the electricity is discontinued the whole system dies. With a less sophisticated society you still have gas-light and other means to move to get light and water, but with too much sophistication there will be less resistence to the forces of the

guerrilleros. We are facing a world where everybody is aiming at more technological know-how, a world where everybody will want to have more technology. In the future, we may hope that there will be a uniform technological world. There is a continual gap broadening between those who are technologically sophisticated and want to be more sophisticated and those who want to refuse and resist that kind of sophistication. We have to find a way to cope with this problem, otherwise the world will be divided into a too technologically sophisticated part and a too technologically resistent part. Pollution is the consequence of the modern approach to science-based technology. Secondly, a challenge to modern technocratic society is deeply represented by the guerrilla It is not only the guerrillas in Latin America, or the peoples liberation front in the Chinese countries, it is also the guerrillas of the students revolts in highly technological societies, who are also fighting against the technocratic society.

Two alternatives come from a despised part of the world which did not want to walk along the lines of this technological evolutionism. There is the Gandhian principle of a Himsa which is a broader concept. It says that people are not supposed to kill either human beings or nature. This, as Dr. Panikkar mentioned, is a passive attitude toward nature. We want to build a model which can take account of every aspect of the world, including the unfamiliar parts. The best thing to do is to be passive, to acknowledge the fact that we are not supposed to control the world, that we are supposed not to kill but rather to live with the other components of nature. This is a fundamental attitude change which is required by the science-based technological society. A second aspect related to this is the Chinese model of the In and the Yan. The In and the Yan usually means there is a plus and a minus or, the earth and the heaven. Acutally, the In-Yan model is more sophisticated. In everything, you have an In and a Yan. In everything you have two principles. You don't judge, or prejudge the nature or the machine or the man. The idea is that in a situation where Western logic is either (a) or (b) but not both, the Chinese logic of In-Yan would say there is an (a) aspect which is a Yan aspect and there is a (b) aspect which is an In aspect. The same man, e.g. to talk a little about Mr. Mao-Tse-Tung, would not say that this man is a Communist and a reactionary. He would say, in this man there is a Communist aspect and a reactionary aspect. In this country, there is a reactionary, hidden aspect which is an In, and a surface, revolutionary aspect - Yan. In this way - and I wonder whether it's a good thing or not - the Chinese Communists were able to be in peace sometimes with the reactionary governments. This was not an either/or type of thing. Since this is not related to technology, I'm not going to talk too much about it. What I mean to say is that in our model, if we could build in a total approach, we would be able to accept co-existence. We would be able to accept co-existence between man and nature, between machine and nature, between machine and man. We would not say that we are going to control nature by machine or man by machine, but we would say that in certain aspects of their model, machine will control nature. In other aspects, nature will control machine. In some respects, man will control machine; in other

respects, machine will control man. In this way, we will have a more subtle approach which will not be an either/or between the technological approach or the anti-technological approach. The problem now is that we may tend to think for or against technology which is wrong. Technology is not something which is good or bad. Now to control nature or to control man is also something which has a good aspect and a bad one. We have to find a middle road, which perhaps will be found only if we who have gone through this modernisation - westernisation - Christianisation process become attentive to the other part of the world and want to give to the Christianisation aspect a different physiognomy, a different aspect. This is to my mind the basic problem I would like the Conference to discuss.

III

DEBATE ON ECOLOGY

Opening Statement by Professor John N. Black (Great Britain)

Until about five years ago man had not been included as part of the ecological system. Only recently have we sought to develop a subject which sees the whole of life in this world and its subtle and delicate balances and interrelationships as part of one large system. Man is part of the environment of all living things and all living things are part of the environment of man. You cannot leave man and his actions out of the system. Ecological opinion has been slow to recognise this involvement of man, basically because of the unwillingness of many academic and scientific people to become involved in the sort of value judgements that loom large when the action of man and his place on the earth are under consideration.

Academic and scientific hesitation to become involved in every-day economic and political problems has been very significant. It is only recently that the academic ecologists have come down from their ivory-towers and have been prepared to look at practical situations. They have seemed to prefer to live in some extraordinary land of their own imagination where all the vegetation was untouched by human hands. Yet it is on the advice of academic and practical ecologists that the rest of the world must depend for the solution of ecological problems.

At the same time, one of the most interesting phenomena of recent years has been the way in which words like ecology, ecosystem and environment have all suddenly become public property. You hardly open a newspaper today without seeing some reference to ecology or pollution or the crisis of the environment or biological time-bombs. It may have been the publication of Rachel Carson's Silent Spring which many people consider overdramatised (but I say thank goodness It was overdramatised), that has led public opinion to rally round the problem of the deterioration of the environment which we see on all sides of us. This public opinion is essential. With the absence of fully informed, I repeat, fully informed public opinion, it is quite impossible to bring to bear on governments, on administration, perhaps even on international organisations, the sort of pressure which can result in steps being taken to obviate the worst of our environmental problems. In my paper I take just three of those pressing ecological problems and discuss them in some length. I will just refer briefly to them now.

The Population Question

First, I speak to the problem of population. From the viewpoint of an ecologist, one or two points about world population and population in general are important. One of the most central problems in all ecology has been population size and the factors which control or limit populations. There are many books, particularly in animal ecology and numerous theories, most of them contradictory, which seek to bring some rational explanation of the way a

population of a particular species is limited and controlled.

The ecologist's view of population is that the size of a population is limited by the resources available to it. There are two ways resources set an upper limit beyond which that population cannot increase: post-hoc - by such mechanisms as starvation and disease which directly reduce the population or which directly reduce the introduction of new individuals into the population; ante-hoc - when in many species in their own natural environment, populations are limited by a subtle and hardly understood mechanism whereby as populations increase the social behaviour of the group alters the anti-ecological balance of the individual in such a way that reproduction is reduced. When these subtle ante-hoc mechanisms are allowed to break down, reliance on the direct, or post-hoc ones, and if I introduce the word Malthusian checks you understand what I mean, swing into operation and affect population size directly.

A glance at a range of species shows that although there is a great deal of evidence that these subtle social mechanisms operate to control population within limits, reliance has to be placed on the direct effects of starvation. In our own species it appears that long ago, social evolution affected the social behaviour and we lost the instinctive regulation of population numbers and, tragically, in many parts of the world, have relied on direct methods for control of numbers.

The ability to decide for ourselves and make conscious decisions about such subjects does not exist in other species. While I have stressed the underlying biological reality that to live requires food and other environmental components, I do not wish to underestimate the particular advantage that man as a biological species has over any other, the conscious ability to decide for himself which way his population is to be controlled, developed, increased or decreased.

Pollution of the Environment

My second subject, is that of pollution. Pollution can be defined simply as the side-products of bad resource management practices. The effects have accumulated because they were not anticipated. It was economically or socially advantageous to disregard or forget them. Natural disasters occur whether or not there is any deliberate management of resources. Sudden floods bringing down mud and other deposits in a stream, thunder-storms, lightning, the effects of fire from lightning create problems almost like pollution. But we should reserve the term "pollution" for the unexpected harmful products of bad management of the natural environment.

Pollution is nothing new. You can look back to medieval cities of Europe and other countries as well, and find abundant written evidence of degrees of pollution. For instance, the river Thames in London was far worse than what we see today. The industrial smoke of the cities of the British Midlands hung

far heavier over the people a hundred years ago than it does today. Take the great Babylonian civilisation which some say collapsed because of the pollution of the soil since the drainage systems weren't sufficient to carry the salts away. Pollution has been with man as long as he has been attempting to control and to develop his own environment.

Why has public concern for the state of the environment become so vocal only within the last ten years? Part of the answer is that pollution is worse in many ways and much worse on a global basis. It is not that we now know we have technical processes which can alter the environment that we set our own future at risk. The main reason for the great and growing concern is the rapidity of these changes in our environment so much so that we can see them before our own eyes. A hundred years ago or more, these changes occurred more slowly and we had time to adapt our own ideas and our social institutions to them. Now we cannot. We can see the changes and because we can see them, and because we do not know how to adapt our way of life to them, we are frightened to such an extent that we take vocal and extreme action. The real clue to present day concern is the rapidity of change and our ability to see, to detect and to realise what action must be taken.

One of the great difficulties facing ecologists is the problem of understanding whether changes which occur are significant changes or whether they are merely part of a random variation around a fairly steady long-term average. Perhaps you are interested in change in a particular element of the plant life, the plankton of the sea. You want to know the effects of increased water temperature, or over-fishing, whether pesticide residues have caused a fall in the amount of plankton in the sea. You can see your data going down and you ask is this a real change. The change in the recorded data the scientists have brought back is falling every year. What you do not know is what happened before you started making records. The decline that you can see here may be a decline from a peak which happened about the time that records started. And if you do not have records, you do not know about other typical fluctuations. Recent discussions reveal that we have not been monitoring the environment long enough to know whether some of the changes we see around us are real and significant enough to be worried about, or whether they are merely variations we should expect in any biological system.

This may seem scientifically abstruse and irrelevant but it isn't. In the mass media and communications industry of today, any small change is picked up and blown up into a crisis. We do not always know whether some little decline or increase which is noted and allowed to be blown up into a first-class biological crisis is a real problem or whether it is not. Here I would like to return to my theme of informed opinion. It is essential that opinion be informed and advised and that a lot of the steam, the heat, be taken out of the ecological debate.

The third subject comes much closer to the heart of this particular conference. It is the whole question of ecological diversity. This can be

shown in two ways. We have the ecologists' act of faith (and ecologists, like people of other disciplines have their acts of faith). It is purely a matter of faith that diversity in ecological systems brings with it stability. Stability, in an ecological sense, refers to the ability of an ecological system to return to its natural balance after a period of shock, after some involvement, i.e. a fire, over-grazing by animals, floods, anything which affects the system and which the system has to adjust to in order to return to its normal position. Diversity, it is said, confers stability. If you want high levels of production from a system, it needs to be simplified. If simplified, it loses its stability. There is very little ecological evidence to convince us this is true. Nevertheless, the belief that diversity in ecological systems is valuable and necessary is a very good example of the way ecological thinking refers back to the whole philosophical position, particularly of Western civilisation.

There are many problems in ecology which cannot be solved by scientific attitudes alone. Ecology, more so than almost any other biological science, possibly the physical sciences as well, rests on a tacit assumption of philosophical views and beliefs which it has inherited from the history of our civilisation. I think this question of diversity goes well back into the whole past of our civilisation, resting on such doctrines as plenitude and the whole Christian doctrine of Creation. The survival of species is another facet. The modern conservation movement rests on the concern that species should not be allowed to disappear from the surface of the world.

In thinking about the survival of species and the maintenance of biological diversity, you come down to three different approaches. You can say this is desirable on aesthetic grounds, that you enjoy it, that you like looking at the wide range of species, you like to be able to show the children a wide range of animals in their natural surroundings. In other words, there is the enjoyment of beauty, however you define beauty. The second line of approach is the ethical one. All species have a right to live. The third is the scientific. A wide range of species is necessary as a gene pool for future biological specialisation. It is necessary for a stability of systems to prevent ecological breakdown and the formation of low grade eco-systems. There is no real evidence as to why ecologists believe so firmly that a wide range of species is desirable. This is one of the points which comes very close to the raison d'être of this conference.

Ecology and Ethics

I have stressed that many ecological problems have major ethical components. The answers to them, although ecologists may be able to offer contributions cannot be solved entirely on scientific grounds. When you ask why we should be concerned for the future of the world, why does it matter, why should we not use the world as we want without worrying about what it will be in the future, you are coming very close to problems outside the ecologists' competences.

High production inevitably involves a risk of breakdown. It exists in many parts of the world already, where the situation is something like a desert. So you are asked to manage the world in such a way as to reduce present day production in favour of the future.

An ecologist faced with this question can ask, why should I be concerned for posterity? Why should I worry what the earth becomes? To many of you, this question is obvious. But I do ask it. The whole problem of the wise use of resources and the integrity of nature is bound up in the idea of our responsibility to the future. Many people have suggested, a search for a way in which our technical involvement with nature is reduced. A "middle way", where complete dominion over nature and complete technical control, which is an absurdity, possibly even a logical absurdity, should be mitigated in favour of a greater understanding of the role of man and what he does in the world. Many of us feel that such a way is necessary but the implication of it is inescapabl If we relaxed our technical involvement with nature, we would have to accept massive reduction in world population and there is no way out of this. We have only been able to maintain world populations at present levels by technical development of our resource systems to such a point that we have raised the potential population to the current level. If we voluntarily decide to relax our technical control and put aside matters as continuing progress towards material well being - if indeed that is a suitable goal - we must say, too, that we are reducing the level of population which the world can maintain. As long as we accept that, we may well consider a relaxation of control over nature We should not talk entirely of world levels. We need to look at this on regional-cultural bases and accept that some parts of the world will have to be reduced in population and others may build up.

I have spent much time in recent years on the problem of responsible use of resources. This is not a scientific problem: science cannot produce answers to problems of responsibility. Basically, it is an ethical problem. Why should we concern ourselves with responsibility?

The whole problem of man in relation to nature in Western civilisation is bedevilled by the position in which man has seen himself apart from the rest of nature, nature being there for his sustenance. This is one reason why it was exceptionally difficult for ecologists to conceive of an ecology which puts man back into this system. This was running counter to many of the developing philosophies of Western civilisation. An examination of Western civilisation has shown the need at all times, a need which has been felt and expressed for some maintenance of responsibility for what we do to the world.

Here, I must declare my own position. I am one of those who Dr. Blake referred to yesterday as not being of any of the churches recognised by this meeting, but persuaded, and indeed it took little persuasion by friends of the Christian faith, to look from outside into the development of Western culture with its firm roots in Christianity. To my own way of thinking, the whole development of modern science has been necessarily based on the tenets of Christianity. Looking from the outside, I can see a whole series of attempts to develop the idea that the dominion of man over nature must be balanced by a

feeling of responsibility. One can see it in the question of the stewardship of man required by God. One can see it in a secular way in the belief in progress, which John Bailey condemned as a Christian heresy, in the philosophy of the French Enlightenment and their views of the judgement of posterity. Those of you who know Diderot, know of his own deep sense of the judgement of posterity.

It is very clearly seen today in secular guise. A man has a responsibility to the society in which he lives, for the maintenance of a responsible use of the resources entrusted to him by society. As I read more widely outside Western civilisation, I find numerous examples of the desire to develop a concept of responsibility to control the way in which we use the earth. It does not matter what your stand point is. There is an almost universal desire from the most primitive or preliterate societies, with their rules and their guidance of behaviour right to the feel for social responsibility engendered in what I like to call the "over-developed countries of the world". Those here today will know the ones to which I refer. There has always been the need for a feeling of responsibility. This is lacking today but I feel a body such as ours can contribute to it most significantly: a "renaissance" of responsibility acceptable to everybody for the way resources of the world can be used.

All Western sciences depend heavily on western religious and philosophic concepts, but ecology more so than other disciplines because the really important questions are not answered on technical grounds alone. They depend for their solution on the acceptable quality of the environment, the integrity of nature, the value of the individual and our relationship to posterity. It is in forming our attitude to these problems that this Council has so natural and so vital a role to play.

Comment on the Opening Statement by

Monsieur Michel Batisse (France)

I am in agreement with everything Professor Black has said and I think the sense in which he has taken and defined the term ecology - in the sense in which man is also involved - covers the new relationship which exists now between man and nature. This is a relationship which must be defined if man is to survive. I also admire the way in which he has gone beyond this debate by transmitting it to another range of interest. This shows that the debate should not merely be confined to a scientific approach. It is perhaps more a question of ethics. In my opinion there is at present a great deal of confusion when we speak about the environment. It is a fashionable word and therefore it is not surprising that this confusion exists; but the people who take the problems of the environment seriously find this confusion more and more distressi

The first confusion lies in the scale about which one speaks of the environment. It is easy to mix the immediate environment - for example such as it exists in this room which for the moment is our actual environment - with the urban environment - such as that of Geneva, or to a more serious extent, those of New York or Los Angeles or Tokyo - and the territorial environment - such as how to make best use of the earth - with the global environment, which is this whole planet Earth (and here incidentally it seems that some imminent catastrophe is upon us).

The second confusion is in the problems posed by the environment: that of standards. First of all there is everything which happens in the 'natural' world - and I think we should put 'natural' in inverted commas for there is nothing very natural on this Earth any longer. This is at the level of basic physical and biological phenomena. This is the world of the biosphere and in this biosphere, man, in his role as the industrial population, has created a new order. The order of the technosphere. And when we speak about pollution and deterioration of the soil it is basically the connecting link between these two spheres about which we are talking. But that's not all. Beyond the technosphere there is all that goes on in man's thoughts which is perhaps what Teilhard de Chardin called the noosphere. Personally I do not know which sphere it applies to most but it may possibly be called the world of ideas. There is an obvious link between this world of ideas, of human aptitude, this noosphere and the technosphere, just as there is also one between the technosphere and the biosphere. But that link is not always recognised. Professor Black has tried to show us how the problems of the environment and the impact of the industrial civilisation on our society are a part of this link.

Another confusion is that which exists among the different situations in different parts of the world: whether it be about the population problem, the pressure brought to bear on the utilisation of resources, the problems resulting from industrialisation or the problems arising from representation of the people and their ethical and cultural concepts. There is a big gap between the different parts of the world and I think that the West has sufficiently violated

this planet, as far as destroying every other civilisation, no matter what the pretext, to now begin to realise that there are other ways of helping to build and strengthen this relationship between man and nature.

I noticed that Professor Black only briefly mentioned the word ecosystem - another word which is very popular at the moment, and I think I understand his reasons for avoiding it. It is one of these up-to-date words which is to be distrusted. However, it is also a word which has the advantage of being able to show that the balance of any situation which establishes itself on this Earth must be based on certain life cycles. Without photosynthesis the biosphere could not exist and yet this seems to be one of the basic factors in life of which the town dwellers of today are completely ignorant. Photosynthesis supports the very existence of plant life.

The existence of an ecosystem depends very simply on the presence of three types of action. First, the producer - who brings about photosynthesis, essentially of plants; second, the consumer - which includes the primary and the secondary consumer and the one who in some measure transforms the organic matter which is made by photosynthesis and, third, bringing the system round full circle, the destroyer or reducing agent - including all the micro-organisms of the soil. This is a simple system and should be taught at primary school. But it is a system which is completely forgotten in the functioning of our modern, artificial ecosystems.

A town is above all a great concentration of consumers, but what we tend to forget is that if this town is to function effectively there must be producers - let us say the country folk - and there must also be destroyers so that the waste matter of the town can be got rid of. Taking the majority of the world's largest cities together, it is easy to see that we are not sufficiently aware of the way in which the urban ecosystem should function. Ecology also teaches us that these ecosystems are easily disrupted. Only a small disturbance is likely to produce serious results.

Finally I would like to stress that today we have arrived at the concept of a vast, enclosed ecosystem on the planetary scale - this comes about through the concept of the biosphere, technosphere and noosphere. This is the concept which has been christened that of the spaceship and it is most certainly what it is all about. The idea, apparent in our history, our habits and perhaps even in our instincts, which has considered the space around us as being merely a void is really a feeling of keeping within the limits: guarding the frontier - a concept which our American friends have portrayed so well on the screen. But it is a feeling which cannot exist today, in our present situation, or at least will not be able to exist in the not too distant future. For if it does, we will find ourselves in an enclosed system. And the philosophical implications of man living in an enclosed environment are considerable.

I think this is one of the important points on which this Conference should focus its attention. I am very grateful to Professor Black for having so carefully pointed out everything that we did not previously know about ecology and in particular, for having shown that some of the impending catastrophes we hear about are only based on figures, repeated from one newspaper to another, which have no great scientific value insofar as accuracy is concerned. No real systematic observing or monitoring of the changes which have taken place in the biosphere, or at least of the most important variables concerned, has in fact been done. There is a great necessity for scientific research in this field on a world scale. The international biological programme has already started work on this and it will be closely followed by UNESCO with its new programme - the intergovernmental programme on man and the biosphere. This covers a whole range of studies which are necessary: studies on the structure and the effectiveness of the biosphere; on the effectiveness of changes which have been produced and, in turn, their results on the resources of the biosphere and, inversely, the consequences on mankind of the changes which the biosphere itself has produced. There are some things which we know about but about which we do nothing. It is in this category that I place all the problems of governmental action, the action taken by public authorities and the action produced by public opinion - which ought to be as informed as possible; and these things, about which we do nothing but about which we ought to do something, are basically governmental problems or problems produced by the structures of society. I hope that the United Nations Conference on this theme, which is to be held in Stockholm in 1972, will try to define what can be done in connection with the environment on the basis of the science and technology which are already available.

Comment on the Opening Statement by

Dr. M. T. Zen (Indonesia)

Coming from the Indonesian archipelago, where at this very moment the rush for minerals and for mineral pools is in full swing, I have something to add which, I think, is of immense importance to the future of man. The economics of mineral industries is certainly fascinating. The rising demand for minerals is somewhat frightening. Take for instance the mineral pools, petroleum. The production of petroleum last year was about 52 million barrels a day and this year it rose to about 56 million barrels a day. What about consumption? Last year the daily consumption in free market countries soared to 36 million barrels and before this year is over it will increase by 2 million barrels. The demand of metallic as well as non-metallic minerals is not less dramatic. Consequently, the present crisis arises as to how we can meet this tremendous demand for minerals. How can we satisfy the gargantuan appetite for raw materials? Can we provide the world's industries with enough minerals in the coming centuries? What are the negative side effects of this tremendous demand?

Due to the progress brought about by science and technology, we have discovered that we don't have to worry about availability of minerals. The problem has changed into how much it would cost to extract them now. There are abundant oil sales, abundant oil fields in the sands and seas and abundant aluminium deposits in the earth everywhere. We don't have to worry about that. Just recently, new oil fields have been discovered in the North Sea, Alaska and Indonesia. No matter what we do, the strain on oil resources still remains; consequently, the rush for minerals and raw materials will still be there and it certainly will affect environmental life. At this moment, about ten rigs for off-shore drillings are in full operation in Indonesian waters. More are to come if political stability permits. In Sumatra and Borneo geologists are invading the tropical jungles. They are looking for ore, for nickel, for copper, for bauxite and for oil.

Being a geologist and one who is interested in mineral economics, I am very pleased. I wish I could see more activity. But, beyond all those promising activities, I see and feel the danger which looms large over the horizon. As I stated before, about ten off-shore drilling rigs are in full operation in Indonesian waters. Daily large oil tankers cruise the Indonesian seas. Imagine the result if one or more of those oil rigs should go beserk, or if one of those oil tankers goes to the bottom of the sea, spilling oil all over. Being a vulcanologist I frequently visit the volcanic islands of East Indonesia and I am very disturbed to find oil spilled all over the beaches and in the seas. The islands on the east coast of Sumatra have been famous for their fish catches for many years. Now those islands are being deserted because no more fish can be caught. In a country like Indonesia which consists of so many thousands of islands, it is very difficult to offer you a statistic. If what I said about fishing on the east coast of Sumatra is true, the question arises: does it have any bearing for the oil activities in the nearby Dumai harbour where Caltex oil is shipped to other parts of the world? I am trying to promote in my country

the awareness of the perils brought by the mineral industry. Speaking as a man from the developing countries in Southeast Asia, I see here several problems.

Most of the foreign companies operating in these areas are only concerned with the profit they are going to make. This is understandable. The countries where these companies operate are only concerned with the foreign exchange they are getting from the oil being pumped out. They lack the manpower which is reall concerned with this problem. If they are concerned, they lack trained people to impose a certain control. Sometime ago, I read in Time Magazine that Mr. Hickel, Secretary of the Interior in the United States, had troubles implementing his regulations to place safety devices on oil drilling rigs to prevent spilling. He complained of a lack of manpower to control this whole business. If this happens in a country like the United States where the control system has been brought to such a degree of sophistication, what will happen to countries like Indonesia, the Philippines or Malaysia, or the African countries where there is only a handful of geologists available. I would like to see an international agency, like the United Nations, impose or try to impose international law against the pollution of oil and be followed by the member countries promoting the same conservation. Basically, the problem is one of conservation. However, the problem goes far beyond conservation. I am not talking about conservation in the romantic sense of Theodore Roosevelt, which says that natural resources or minerals should be left untouched in the ground. What I mean with conservation is the most efficient practical recovery, processing, use and re-use of non-mineral raw materials that present-day technique permits. I still think the world-wide conservation movement can help slow down pollution and promote a more responsible use of natural resources. Since this is a world problem affecting the whole of mankind the movement should be world-wide too. Most of all, I would suggest that a United Nations Agency, such as UNESCO take th initiative towards this movement, followed by conservation associations all over the world.

I want to make an appeal to all of you in this room. Be concerned with this problem and urge the promotion of an international law against pollution of oil, and a law for conservation in its widest sense. This is a problem which will decide whether we and our children in the years to come, will live in happiness or misery. For those developing countries which yearn for industry, I would say industrialisation is a must. The natural resources should be developed, but you had better know what you are doing before it is too late. As a geologist working in the mineral industries, I know it is possible to direct natural resource development toward a better tomorrow and a better life for everyone on earth.

Comments on the Opening Statement by

Professor Fred H. Knelman (Canada)

My problem is I have a book to speak about and, unfortunately, I have to give you the Reader's Digest version. I want to give you a perspective of the environmental problem. If we are going to cure this particular disease, we must not treat it in terms of its symptoms. We must do what Professor Mushakoji suggested: understand the nature of the disease and think in terms of a cure. First, we must look at technology in the developed world, in the industrial and the post-industrial world and in those countries which are dedicated to that path, that particular path of development. Technology is characterised by being almost totally laissez-faire, having virtually no controls, being characterised by constant ascendancy of means over ends, and having a particular growth which is very interesting. I think this equation of growth will become as famous as Einstein's $E=mc^2$. It is called exponential growth. All areas central or peripheral to technology are growing exponentially. The shape of the curve tends to become almost vertical, if we look at nuclear power, for example. The bomb dropped on 6th August on Hiroshima was about 20,000 kilotons. In 1954, the bomb exploded in the Marshall Islands was 8,000,000 tons (T.N.T. equivalent). That kind of growth, that multiplication of power by millions, corresponds to the power of communication, where the computer communicates at incredible speeds compared to ordinary human communication mechanisms. You might look at it in another way. 82% of all scientists and technologists who ever lived in the history of civilisation are all alive today. The doubling period roughly is every ten years. Now, this particular growth is not accompanied by the growth of human social, ethical, legal institutions designed to control technology. So we have the well-known phenomena of cultural lag, which can be thought of in a number of ways. It can be thought of in the disparity between quantity and quality, between power and love or between technology and the control of technology for human welfare.

In that cultural lag between social institutions necessary to control technology and its uncontrolled growth, lies the crisis. I find that more and more the root of the problem is that we are faced with a gigantic crisis of values, a world crisis. That is why the subject of this conference is so fundamental. Let's try and understand this in terms of how pollution occurs.

Pollution occurs because the norms of power - whether we are talking about political or economic power - the norms of power in all developed states, industrial and post-industrial, are served most directly, most immediately and in the greatest return or payoff by technological eminence. That is why there is a set of reinforcing structures, of self-perpetuating and supporting structures, of economic and political structures with technology. Decisions about technology virtually tend to become a kind of rubber-stamping of the ascendency of means. We see this repeatedly. What we are really suggesting now is a fundamental break, change or revolution in the nature of economic and political structures to bring this insane growth into check.

As all growth involves a Malthusian dilemma, so pollution does. The end result of pollution is ecological disaster. The end of the arms race is the nuclear holocaust. The end of the population growth is war, disaster, misery and suffering. All of these growths, all of these great problems have an inherent Malthusian dilemma. Pollution arises because, within the norms of our economic and political structures we defer social costs. It does not matter in what ideology or ideological setting we are operating because all the great powers defer the social costs of pollution. In this way, they delude themselves on their returns from invested capital. It is a delusion and the end is ecologic depression where industry comes to a standstill and the world is too polluted to go on.

Technology in the industrial and post-industrial worlds operates as a kind of self-perpetuating system. It is inherent, anti-ecological and operates outside of the natural milieu. It does so largely because the payoff in terms of the norms of power are so compelling to be irresistable. Pollution arises as a backlash, the backlash which exists from deferring the social costs of pollution. The ultimate question now is what system of human values, goals, priorities, choices, political and economic structures must we create in order to survive. That is what is now involved.

It is very difficult to give a timetable to disaster. Some people of perhaps low credibility have spoken of twenty years. We do not know the nature of the disaster. Will it be nuclear war? Will it be "eco" disaster? Will it be a population explosion or will it simply be an explosion of the most overwhelming problem, the mal-distribution of justice, health and wealth? This is the total environment. More and more, we must be concerned with the total environment. For me, the problem is reduced ultimately to a question of human values. These are the questions we must grope for in this conference.

IV

DEBATE ON BIOLOGY

Opening Statement by Professor L. Charles Birch (Australia)

The genetic control of man's future and man's capacity to control human behaviour are questions which arise from the scientist, especially the biologists, who ask for help as they seek answers to their dilemmas. These are not questions which the Church is asking of science, but which science is asking of the world.

As I move among my fellow biologists, I feel a very sincere concern about the implications, particularly in genetics and behaviour, of the modern revolution in biology. There is a great deal of misunderstanding amongst non-scientists as to what is fact and what is fiction. Two sorts of consequences can come from our discussion of these questions and issues. First, we should raise issues that can be explored by the Department on Church and Society which will then be filtered down to churches throughout the world. Secondly, and here I express a personal concern, the World Council of Churches could perhaps be a body to help the scientist find some answers to his groping for enlightenment because we know we don't have answers to the deeper ethical issues. There is, I think, a very receptive mood, particularly amongst biologists today, to meet and discuss with specialists in other areas. However, they would not, naturally, turn to the Church. Most of the biologists I know, consider the Church the last institution in society in which to find any answers. A tremendous breakthrough would occur if the World Council of Churches did produce something helpful to meet the yearnings of biologists of this decade.

Today science presents some very sincere questions which have implications in theology. Paul Ehrlich, who many of you know as the stormy petrel of American biology, particularly in the areas of population control and the deterioration of the quality of the environment, and who is often very critical of the Church, said to me a year ago that underlying all the particular questions we are asking about genetics and population is one outstanding question: what are people for? If that is not a theological question, I don't know what is.

A second question which we biologists are finding central, particularly in our concerns for conservation and the quality of the environment, is what are non-human living creatures for? We don't find it at all helpful in conservation simply to think in terms of the usefulness of living organisms to man. In Australia, for example, we have the problem of the conservation of the kangaroo. We have several dozen species and it is very difficult to argue for keeping more than a couple of them, when they compete with sheep and particularly when their main usefulness is to boost the tourist trade. Americans especially like to see kangaroos, but they'd be satisfied with one species. A number of species have already been shot out. Cartoonists in Australia are now redesigning our coat of arms, which consists of a kangaroo on one side, an emu on the other and something else in the middle. In the cartoons the kangaroo is very often shown replaced by a can of cat food, because that is what's happening to many of them. We need an ecological ethic, an attitude toward nature which goes

beyond mere usefulness. Otherwise, conservation is a lost cause. Here, the Church can do something tremendously powerful if it has something to say which will cut ice.

The control of human behaviour is very much with us just now, and the question of genetical control of the future of man is a likely question for tomorrow. (The science-fiction of today has a habit of turning up as the fact of tomorrow.) It is very important that we anticipate the issues arising in the genetic control of man.

A word about the problem of the control of human behaviour - Dr. von Weizsäcker said that the molecular biologist, who has been so successful in unraveling the nature of genetics at the molecular level and put so much power in the hands of biologists is now turning his attention to the second great problem area in biology: the analysis of the nervous system and brain function at the molecular level. There are few people who would doubt that if similar discoveries can be made at that level we shall have information in our hands for the control of human behaviour, far beyond anything we possess at the moment. What we possess at the moment is largely the result of very empirical experiments, shoving electrodes into brains and so on. But, the process of controlling behaviour either by electrode implantation, by drugs, psychological conditioning or some form of brain surgery put very powerful weapons into man's hands.

Several things raise questions for us. One is the whole business of finding a short circuit to sensation and experience. The students I spend most of my time with are very concerned about the phenomenon of experience. If you can get a short cut to experience, is there anything against it? One of the theologians in his contribution talks about science providing a cafeteria to supply all our needs and wants. The cafeteria will include the push buttons to turn us on, or to turn ourselves on, in the same way as the experimental rat when it is confronted with a button that it presses to give a sensation, a sexual sensation, or some sort of erotic experience. For a rat the experience is so enjoyable that it keeps on pressing it all day long.

The second concern here is the whole business of other people controlling the behaviour of individuals or groups. It is done with cattle in fields by remote-control radios. It could be done with people. There are plenty of ethical issues there. We know very little about guidelines which might help us. A third thing, a difficult issue, is the extent to which psychological conditioning really is an ethically-acceptable thing. It is being used now extensively with problems like homosexuality and alcoholism. It seems to me rather like the use of the penalties of hell fire as a way to motivate people away from a certain behaviour. How much should fear enter into the way we condition people? Could we end up with the Clockwork Orange, the novel in which the whole of London in the year 2000 is conditioned to behave in the way

the government wants it to.

The last question I raise is not whether we should control man's genetical future, but how and to what ends. Modern medicine, not by virtue of curing or not curing, but by virtue of removing the symptoms of many genetical diseases is, of course, resulting in an increase in the frequency of bad genes in the human community. That is evolution. Medicine has changed the direction of natural selection. The definition of evolution is simply a change in the sorts of genes present in a population. Such evolution has been determined by the modern practice of medicine. Now there are geneticists who are raising questions about the doom of man if he goes in that direction. If you have read Dobzhansky's paper, you will quickly see this is a very controversial issue. Geneticists are not agreed as to the extent to which there is a gloomy genetical future for man, and if we keep on going this way, whether it is or is not a very serious threat to man's genetic future. But we are increasing what the geneticists call our load of mutations by the practice of modern medicine. So that willy-nilly we are controlling man's future. But, should we take more direct steps? Which are the questions raised by eugenics and by so-called genetical engineering?

Negative eugenics, that is to say the deliberate removal of deleterious genes by either sterilization or by genetic counseling, has not had a very happy history to date. We have not been able to identify the people who carry deleterious genes. But there is a revolution going on there and it is now possible to identify the carriers of quite a number of genetic diseases and the number of such diseases which can be detected is increasing. This gives us the possibility of reducing the incidents of such diseases by persuading the carriers not to have children if the chance of a serious deleterious disease turning up in the children is very high. This is important and raises the whole question of how serious the disease has to be before we should persuade parents not to have children.

When we come to the area of positive genetics which has been promoted in this decade mainly by Julian Huxley and H. J. Müller, we've got proposals for adding to the quality of the human race. I think the problem most of us have here is what qualities do we go for? It is perfectly feasible that through the operation of sperm banks and later ova banks, soon it will be possible to bring chosen groups of sex cells together and people can make the choice about having their own children or determining whether they will have somebody else's . I wonder whether, if Professor Harvey Cox had asked not what would you like most in the year 2000 but what ten qualities you would like most in all human beings in the year 2000, we in this room could agree on that?

I think more emphasis is going to come on germinal choice in the future with the whole problem of the complete separation of sexual activity from procreation. What are the ethical problems there? Do we have objections to this?

There are two remaining issues. As I have indicated in my paper the most positive form of positive eugenics would be cloning, simply taking cells of individuals whom you might like to propagate and artificially propagating these into fully complete beings. A year ago, we would have said this is a completely nonsensical idea, but within the last twelve months, this has been done with frogs People ask why on earth would you want to fill the world with frogs all of the same genes? That is not the point. Suppose we could do this with human beings. It might be very worthwhile to have chloroplasts, chlorophyl, in all the cells on our back for example, so that when we go for a swim and take off our shirt we could in fact manufacture our own food the way the plants do by exposing themselves to the sun. That would be a way to overcome individual food problems. We are already one step on the way there. Chloroplasts have been transplanted into animal cells and have photosynthesized in animal cells in culture. This is the first step. We can build science-fiction on the first step but who knows what may come of that type of experimentation with cloning.

The last thing to mention is this tremendously big area of genetical engineering which is the manipulation of the gene itself. This is important for the future of medicine, with signs already that some diseases could be attacked at the gene level, you transform the gene and if you are born with a bad gene you get rid of it, or change it into something which is better. Transformation has been achieved in viruses and in some higher cells. Now, to take a hundred steps from there and say we shall have transformation in man in terms of anything producing something new may be many many years away. Perhaps we will never get there, but in terms of transforming something deleterious, this may be just around the corner. This would be a tremendous gain for medicine and poses the question to what extent man should manipulate the genes with which he is born. Many questions are being asked by the genetical engineer about genetical tailoring of mankind. Although it is science-fiction at this stage, I think it is important to turn our attention to it, not only because it might be a fact tomorrow, but because all the Sunday newspapers are writing about it as though it is fact today. People are asking questions and we ought to inform ourselves and the rest of the world about what things are fiction at the moment, and the judgements we might have to make in the future if some of these things come true.

Comments on the Opening Statement by

Professor Warwick Estevam Kerr (Brazil)

The last decade was prodigal in biological discoveries. In 1961 François acob and Jacques Monod conceived the idea of the Operon which carries out the enetic control in lower organisms; this theory opened the field to much esearch, gave them the 1965 Nobel Prize and provided the basis for the Britten nd Davidson hypothesis of genic control in higher organisms in 1969. In that ame year (1961) Marshall Nirenberg and J. H. Matthaei began the deciphering f the genetic code; this discovery was a link in the chain that connects the very, McLeod and McCarthy experiments of 1944, which pointed to the DNA as he carrier of genetic information, to the isolation of the gene by J. Shapiro, . Machattie, L. Eron, G. Ihler, K. Ippen and J. Beckwith in 1969. The year 963 saw a new hope for the over populated regions of the world: Drs. Edwin Mertz, liver Nelson and their graduate student Lynn Bates perfected two types of corn: paque-2 and floury-2 that produce 7 to 8 times more protein than man can digest han regular corn, besides having high-lisine content. Everything indicates hat we are right in the middle of the Scientific Revolution, which has begun round 1940. Laboratories increase in number and production. In my laboratory, small group of 25 enthusiastic young people (including myself, I am 48, the ean age in my laboratory is 25.5 years) working in an underdeveloped country ut with very well developed techniques has a rate of about one discovery each 5 days. Just a sample of them: Mr. J. O. Machado discovered that the Brazilian ocial bees live in symbiosis with a bacillus he called Bacillus melipotrophicus, hich breaks proteins of pollen in their amino-acid components; I have demonstrated hat about 20% of the genetic load of bees are sex-limited; Prof. A. Carlos Stort btained a complete analysis of aggressiveness in bees and found only 8 genes esponsible for such behaviour; Miss Therezinha de Oliveira found human milk to e polymorphic in at least three loci which control protein components; Miss onceiçao Camargo found coconut water is ideal for diluting bee sperms and keeping hem alive for about one month, improving our artificial insemination conditions; he and I found that the addition of automobile radiator "Bardahl" makes ideal onditions for counting sperms. These are just a sample of the things discovered n these last 90 days in my laboratory.

Efficiency and accuracy in Science are increasing every day in all directions. ome of the richest countries are expending as much as 3% of their Gross National roduction in research. About 90% of the geneticists which ever existed are still live. We, geneticists and biologists of the world can cry quite loud as the embers of the Church of Laodicea: "I am rich, and increased with goods, and have eed of nothing" (Rev.3:17a). However, I believe we could also receive the eprimand: "and knowest not that thou art wretched, and miserable, and poor, and lind ..." (Rev.3:17b). We have been blind, and our lack of high standards of ehaviour are easily manifested when our countries enter in exceptional type of overnments. Even more, all the tremendous advance in biological science of our ra has not been accompanied by a general wealth of the people of the world, has ot been used to heal the needs of the earth. I believe that the main defects of ur behaviour are:

I. Biological scientists are not putting science into effective use for the people. There is an enormous gap between scientific knowledge, scientific research, and its utilisation by the populations. However, in this respect the developed countries can count on a good number of science journalists who try and many times succeed in filling the gap. The opposite happens in the underdeveloped world. Many times scientists of the Third World work in programmes that make their laboratories nothing more than outgrowths of particular laboratories in developed nations, working in projects that will help to solve problems of the developed world. You may be surprised when I tell you that the number of fly geneticists plus human geneticists in Brazil is six times greater than the number of cattle geneticists and beans geneticists. I am not saying that one should work only in applied science or in local material, but that is our duty to be permanently connected with the problems of the people which surround us, and participating in "think tanks" to solve their problems. The prime consequence of Pentecost was the decision of the early Christians to share all goods and wealth. Nowadays such decisions must include the sharing of all knowledge and all the "know-how" which may be good for all mankind.

II. Scientists see the problems but rarely participate in them. Scientists "pass by on the other side". Many times we see the problems, we see the solutions for them, but keep them for ourselves. Of course, there are causes in the conditioning of such apathetic behaviour. One, that happens with me very often, is the punishment or the lack of reward, namely, one, two, three suggestions are thrown in the waste basket by PEOPLE IN AUTHORITY. However, when this happens it is because either our suggestion was a lousy one or because we are ahead of the time, at least in that particular micro-ecological niche. It is necessary for the scientist to educate people in authority so that they become receptive to new ideas.

Communication is a very important task. It is so important that, for the sake of communicating God's will, Christ became one of us. Many times I see some bees working in a nectar depleted tree and think: "the only way I have to communicate with this bee, if I could, would be to become a bee and use its means of communication". The scientist who is a Christian must leave his ivory tower and mingle with his own people, trying to become part of it, in order to save it from ignorance, from bad health, from bad economic conditions and bad habits.

I know that this is possible in any circumstance, in any government. Last year besides my work of teaching and research I managed to find time for making 27 lectures to a total of 1,000 people of all sorts, students, farmers, industrial workers and so on.

Another technique is the epistolarian one, that is, giving our witness through letter writing. It is gratifying to see an open letter to the President Nixon from Dr. T. M. Rizki, Dr. R. W. Hill and 81 people associated with the Department of Zoology, University of Michigan, published in Science of April 10, 1970, page 197, in an effort to incriminate and erradicate bacteriological weapons.

They suggested that the activities of Chemical and Biological Warfare be turned toward research for aiding in restoring a harmonious ecological balance, using the vast experiment and equipment of CBW for the improvement of the USA environment - a "swords into plowshares" programme at the biological level - they called it.

I may agree that many a good scientist is "passing by" because he is ill informed or not informed at all and has not detected any problem worth his effort for "the man stripped and wounded on the road to Jericho". Let the scientist consider for instance the problem of the exploitation of the underdeveloped countries by the developed ones. Let him consider the prices the developed countries pay for the raw products and the prices they charge for the manufactured goods. Let him check the amount of labour involved and he will quickly discover his part in the exploitation. Consider again the number of educated people who migrate from underdeveloped to developed countries after receiving food and education for 25 to 30 years. Just when they are ready to give back to their own society in specialised work all she spent on them they migrate and do this for another society. I believe it is a good mission of the WCC to make these points clear for the developed nations.

I wonder how many scientists know what is "institutionalised violence". When there is an earthquake, an airplane accident, a gas chamber, we are more likely to get horrified. Everyone of us was horrified with the killing of six million Jews; but we easily accept an infant death rate of 200 per 1,000. Since developed countries have per thousand births an infant death rate of 37 the above rate means that 163 per thousand births in North Eastern Brazil are dying due to the institutionalised violence; at a rate of 130 per thousand, we estimate that more than eight million children died from the end of the Second World War to the present, in Brazil.

Finally, one more point should be stressed here; in a world in which science and technology are becoming more and more important it is tragic to see that many societies shall have evils that could be removed. If these evils still exist it is because we have not fought hard enough. I mean war, terrorism, torture, dictatorship, violence, lack of freedom, violence against scientists, against labourers, against students, against women, against children. A whole international jury was held and condemned many nazis in Nurenberg under the principle that no man has the right to obey an evil order. I believe that a WCC first class objective would be to bring this principle again and again before world leaders, scientists and especially, military men, from both developed and underdeveloped countries.

I believe also that scientists who are Christians have to be involved in providing a proper environment for the development of justice between nations and within nations. The tendency of many scientists is not to commit themselves to anything that might defy their superiors, or risk their jobs. They very often rationalise their positions and say that politics and science should not mingle that the scientist must be objective and therefore non-committed. However, this is also a biased attitude, since they have adopted the commitment to avoid change, avoid humanisation, avoid love and all its consequences.

Comments on the Opening Statement by

Professor Agnar P. Nygaard (Norway)

I am sorry to be dependent on the manuscript, but I did not know I was going to take part in the panel discussion. I am also going to talk a little about eugenics in connection with human dignity. Our genes are not principally different from those of animals, so we are submitted to the same laws of mutation and selection. The point of view that man is a part of nature, is not only the thesis of materialism but also that of the Bible. At the same time, however, the Bible does not identify man with nature. One implication here is that the undeniable destructive tendency in man cannot be viewed as a part of nature. It is something that is placed at the centre of human personality. Therefore, the basic pessimistic prospects of the New Testament cannot be denied. New evils will arise at each stage of growth and insight. This is certainly the case with eugenics and the improvement of human genes. (I was a little surprised this afternoon that this prospect was not taken into account in connection with the economic discussion. In the very developed countries, at least in the Scandinavian countries, there is a problem of abundance. What is worse, to die mentally or spiritually in a state of abundance or to die in North-western Brazil from lack of food? I don't know, but both are terrible.)

So the problems are with us and the problem concerns eugenics, the desirability of improving the human body. The Christian outlook is, of course, for growth, for development and improvement, but can this be realised without new perils of evil?

I am rather sceptical to several things mentioned by Professor Birch. I don't think that they will be actual possibilities in the near future. Still there are many things that will, or can be done today, sperm banks for example. Well, it is a start. It will be in use in America to some extent and in the Scandinavian countries. Still closer to us is the problem of experimentation with embryos and the removal of them in the early stages when the deficiencies are discovered. This is a problem very close at hand. In the last year many diseases have been detected by just examining the amino fluid of the cells that are there and showing the greatest of metabolic errors. Now, perhaps, many people will say, or will not say, this is a problem; and from a purely materialisti or a naturalistic point of view, it is not a problem. There are enough people in the world, and one can remove disease that way. There are also economic advantages to it. I just dealt with a proposal of the Scandinavian Genetic Institute which is going to be built just for this purpose. One of the arguments for this was this would be a very good economic thing. One could say one would save ten million dollars a year by removing one per cent of those born with metabolic defects. I am not sure there is such an advantage with this sort of thing and it is hard to prove it. There was no obvious reason for Hitler to take the lives of imbeciles and people with diseases in Germany but still I think this whole mechanistic attitude toward human dignity bears a kind of punishment in itself. I think this is clearly stated in the Scripture where the embryo is included in God's care. We may think and believe that we understand

ourselves and can direct the historical development. However, I do not think this is right and I don't think this is the Biblical way of thought. We are limited and we have to start with something. One of the things we have to start with is human dignity, and that each of us has immeasurable value, whether we are intelligent or whether we are formed or not. So even though the essence of Christianity is that we are free, we are still bound by restraint, by these axioms and the perfect being, the perfect body is not the ultimate good. The perfect good is not to make everything easy for ourselves. Kierkegaard found his calling was not to make things easier for people but to make them harder. I think that the eugenic plans which can be realised today are one way, one of the many attempts of man to seek to complete history prematurely. Christian thought is that Christ will complete history, through a supernatural happening. Even though we are called to work for a paradise on earth, I think it will never come, without this supernatural intervention.

Comments on the Opening Statement by

Professor Nobuaki Sawada (Japan)

I cannot speak my mother language here and my poor English is not sufficient to discuss highly sophisticated and complicated problems. Dr. Weizsäcker and Dr. Birch have already pointed out the ambivalence of modern biology including biological research, genetics, development of biology, and behaviour research in animals and ecology. I agree almost completely with their opinions so I will point out another kind of problem. Many discoveries in animal and human physiology are leading us to resolve the mechanism of our bodies. With the procedures of surgery and electronics, or bionomics, we can transplant some of the organs, like the heart, or substitute for an organ some mechanical system, for example artificial arms, artificial kidneys or artificial heart. Such cases are not sufficiently successful today, but in the future we might succeed in transplanting almost all the organs, despite many technical difficulties. I think the brain is the most difficult organ which might be substituted or transplanted. Perhaps the brain will be the only organ which cannot be substituted or transplanted by others.

But this technologically improved man, is that a true man? That is a problem. Probably he is truly a man, and he also has a personality if he is to keep his own brain. But if his brain was substituted by another or other mechanical systems, I don't know the answer.

This must be a curious dream of biologists. I think it will be a very helpful speculative experiment to clarify the essential nature of man or mankind. What is a man? Many of their functions can be substituted by mechanics. This problem will lead us/the next problem, the religious problem. What is the /to Christian faith? When a man joins some Confession is he a Christian? When a man behaves as if he is a so-called Christian, in a situation, is he a Christian? Does he react as a result of conditioned reflex? Isn't he a machine reacting to the total sum of physical-chemical energy changes within and without the system? We have to answer this question. How can we challenge such an idea? We have to answer this question by the collaboration of scientists, theologians and philosophers.